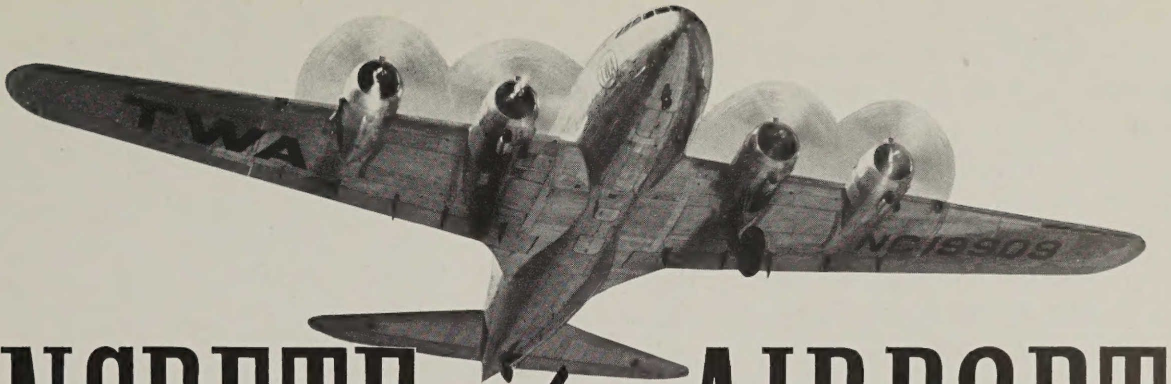
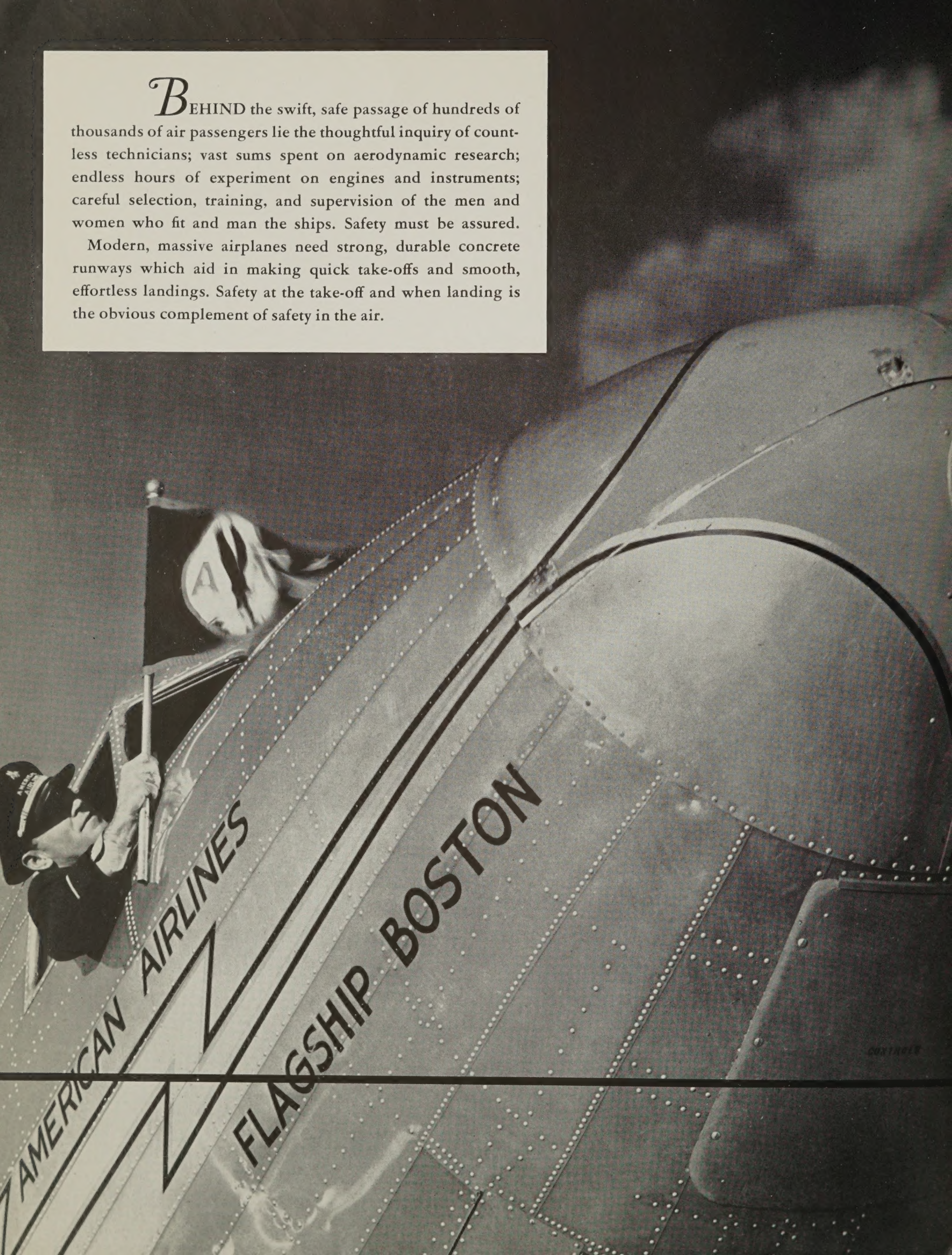
April 1948



CONCRETE *for* AIRPORTS

BEHIND the swift, safe passage of hundreds of thousands of air passengers lie the thoughtful inquiry of countless technicians; vast sums spent on aerodynamic research; endless hours of experiment on engines and instruments; careful selection, training, and supervision of the men and women who fit and man the ships. Safety must be assured.

Modern, massive airplanes need strong, durable concrete runways which aid in making quick take-offs and smooth, effortless landings. Safety at the take-off and when landing is the obvious complement of safety in the air.



A message to all those vitally interested in the development of major and intermediate airports*: *For safety, economy and comfort, portland cement concrete is the best material for runways, taxiways and aprons.* Here are the reasons why:

Concrete airport pavement aids flying safety

1. It has high visibility
2. It has high skid-resistance
3. It has a low crown
4. It is free from loose particles
5. It makes take-offs and landings easier

Concrete airport pavement is economical

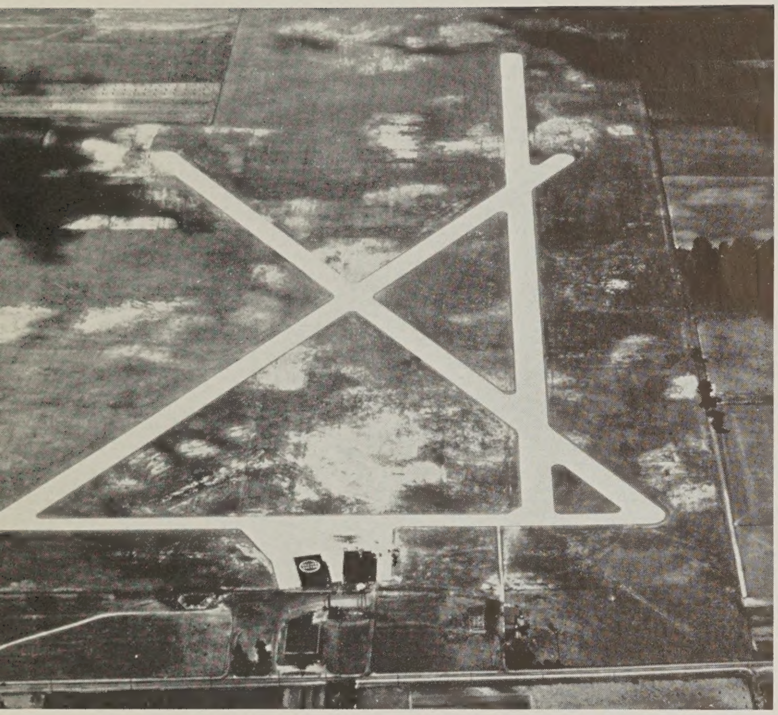
1. It can be designed to carry any weight of plane
2. It has a long life
3. Its maintenance cost is low
4. It is easy on equipment
5. It saves in lighting costs
6. It permits maximum pay loads

For these reasons, and because concrete assures comfortable, shock-free, pleasant landings, it is the airport pavement preferred by passengers, pilots and management.

**For secondary municipal and auxiliary military airports and for mass take-off areas, temporary and emergency runways and parking areas, soil-cement offers a durable light-duty pavement at low cost. Write us for complete information.*

Front cover: Airport shown is Bowman Field, Louisville, Ky.; Airplane photograph courtesy of TWA.
Facing page: Photo courtesy American Airlines.

CONCRETE *has high visibility*



This unretouched photograph of the Dayton, Ohio, Municipal Airport leaves no doubt about the high visibility of concrete for runway pavement.

WE see objects by light which is reflected from them to our eyes. Measurement of reflection by skilled observers with scientific equipment has shown that concrete reflects several times as much light as is reflected from dark colored pavements. This means that the pilot sees a concrete runway several times better. That's always desirable; but when the margin of safe visibility is low, it is of supreme importance.

Concrete has a highly desirable matte surface. Light striking it is diffused, is visible in all directions. This is in sharp contrast to light reflected from specular (shiny) surfaces which may have a glaring intensity in one direction but, in other directions, may have such low intensity as to be almost invisible.

Pilots can spot concrete runways as far as 40 miles.

At night, or when visibility is low, concrete's high light-reflective value is an especial aid to safe flying. Cost of lighting is greatly reduced.

. . . skid-resistance . . . low crown

Especially at night, concrete's light color makes it easier for the pilot to pick up the runways and see them clearly as he lands.

●

Heavy planes landing at high speeds must have skid-resistant surfaces so that the brakes can stop them within the length of the runway. If one wheel skids while the other holds, a ground loop is the probable result. Nose-overs and other accidents may be caused if uniform, skid-resistant surfaces are not provided.

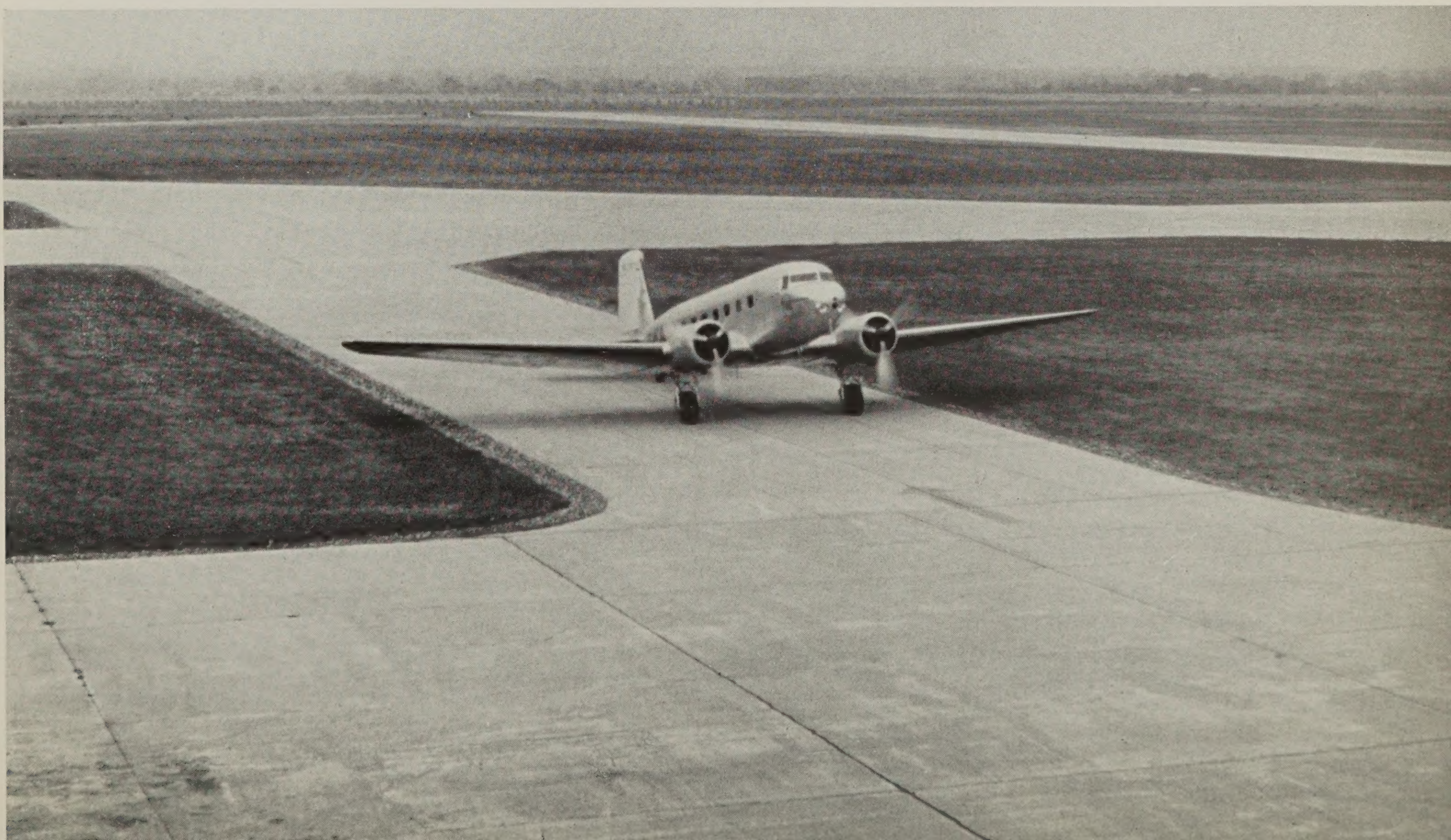
Concrete's gritty texture gives ample and uniform grip to the tires. While all paved surfaces cause some wear on tires in landing, concrete runways can be built to reduce wear to a minimum. Any degree of surface grittiness desired can be obtained with concrete. And just as important—concrete retains this uniform, skid-resistant quality for many years.

●

Crown is given to pavement to insure drainage. It should be kept as low as possible and still insure rapid and complete run-off of rainfall. With some materials and methods of construction, it is difficult to obtain adequate drainage. Such runway pavements must be given high crowns to avoid water pockets made by depressions. This is not true of concrete. It is laid accurately to specified grade and crown and its true surface insures rapid and complete run-off.

The low crown which may be used on concrete reduces the tendency of planes to veer toward the edge of the runway and away from a straightaway course. It is a major factor in safe take-offs and landings.

Tires of a landing plane grip concrete evenly and surely: its low crown assures complete and quick run-off of rainfall. Concrete is not injured by oil drippings or gasoline.



When a pilot "revs" his motors preparatory to taking off, concrete contributes no loose stone chips or pebbles to damage equipment or injure passengers. Nor will the turning action of his wheels damage the concrete as he swings into position.

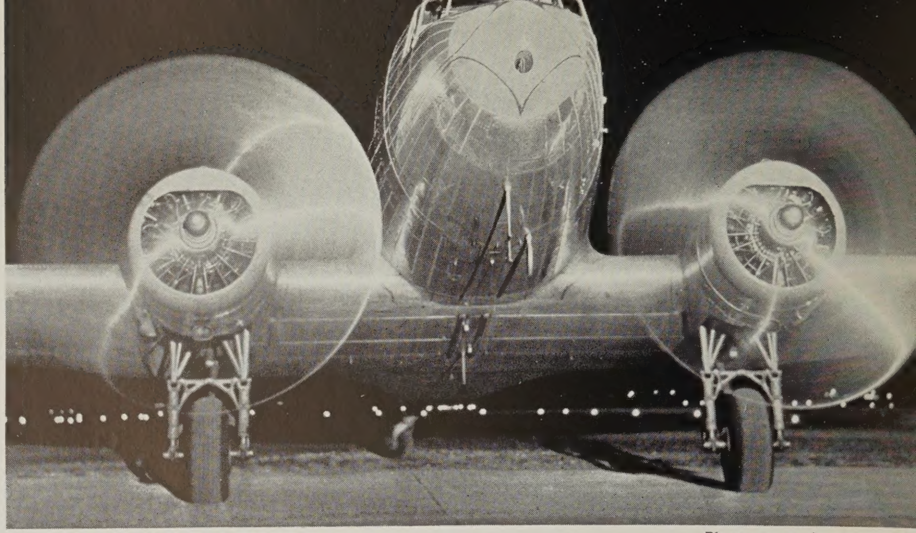


Photo courtesy American Air Lin

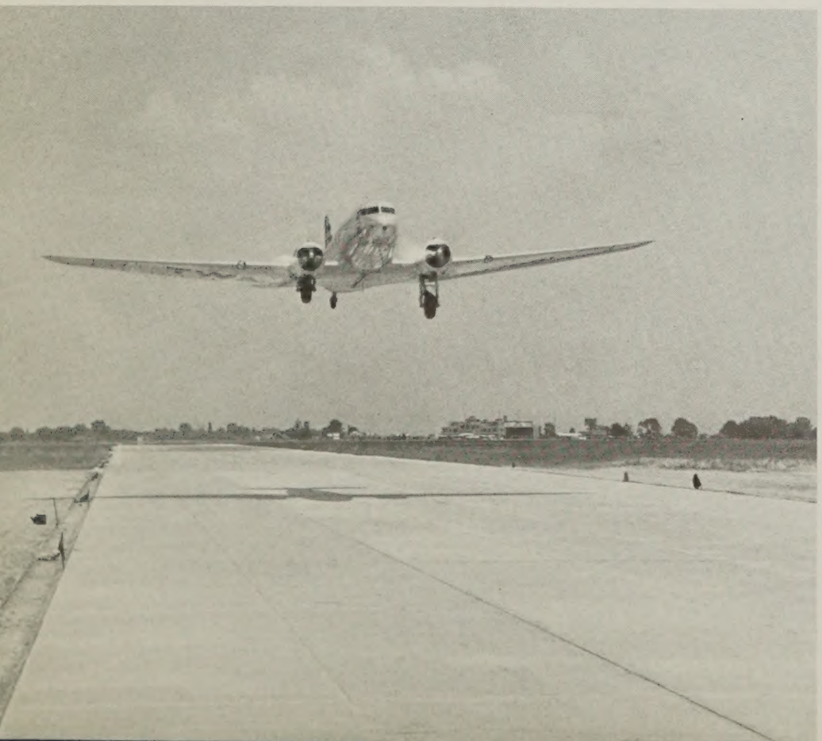
CONCRETE *is free from loose particles*

DUST and dirt on airport runways are an annoyance to passengers and personnel. But loose chips and pebbles are a serious menace to flying safety.

Picked up by the propeller stream when the engines are "run-up" prior to taking off, they are thrown with great force against propeller tips, engine cooling fins or control surfaces of the plane. Individuals have been injured by them.

Even a small nick in the propeller tip caused by a flying pebble may have serious results after the flight is under way. The best of maintenance cannot insure propellers against being damaged in this manner. The damaged propeller may set up vibrations severe enough to tear the engine from the plane. This damage to propellers is not a theoretical danger but one which caused, in a recent two-year period, 18 per cent of all accidents due to power plant failures. Concrete contributes no loose stone chips or pebbles to endanger flying safety.

CONCRETE *makes take-offs and landings easier*



AN airplane rolls easily over concrete runways because of their rigid, even surface. There is a minimum of rolling friction. The plane gets into the air quickly, clears obstructions at the edge of the airport with a greater margin of safety than would be possible with an uneven surface having a higher rolling friction.

Planes starting from concrete runways can get into the air with a maximum load. This means that on long flights there will be less danger of forced landings due to exhaustion of the fuel supply.

In landing on concrete the pilot has an assurance that there will be no surface irregularities to trouble him.

On concrete runways the plane is in flight in minimum time. There are no bumps to jostle passengers. Before they realize it, they are in the air.

Landing is smooth and easy on a concrete runway. The pilot is assured that no high crown or surface irregularities will deflect him from a straightaway course.

Photo courtesy United Air Lines

CONCRETE *is the economical airport pavement*

CAN BE DESIGNED FOR ANY PLANE WEIGHT

NOT so many years ago, when planes were small and few in number, little thought was given to adequate strength of runways. But tremendous forward strides have been made in air transport. Both in weight and numbers, commercial and military planes have increased at an amazing rate. At major airports several hundred planes of all classes take off and land daily. Planes built or building weigh up to more than 140,000 lb.

Further increases are inevitable. Pavement of substantial strength is required to carry such heavy wheel loads.

Just how strong should a runway be? If not strong enough it may fail prematurely under traffic or require excessive repairs to keep it in service. If too strong, the first cost is greater than necessary. For economy, the pavement should be designed to fit anticipated loads and traffic.

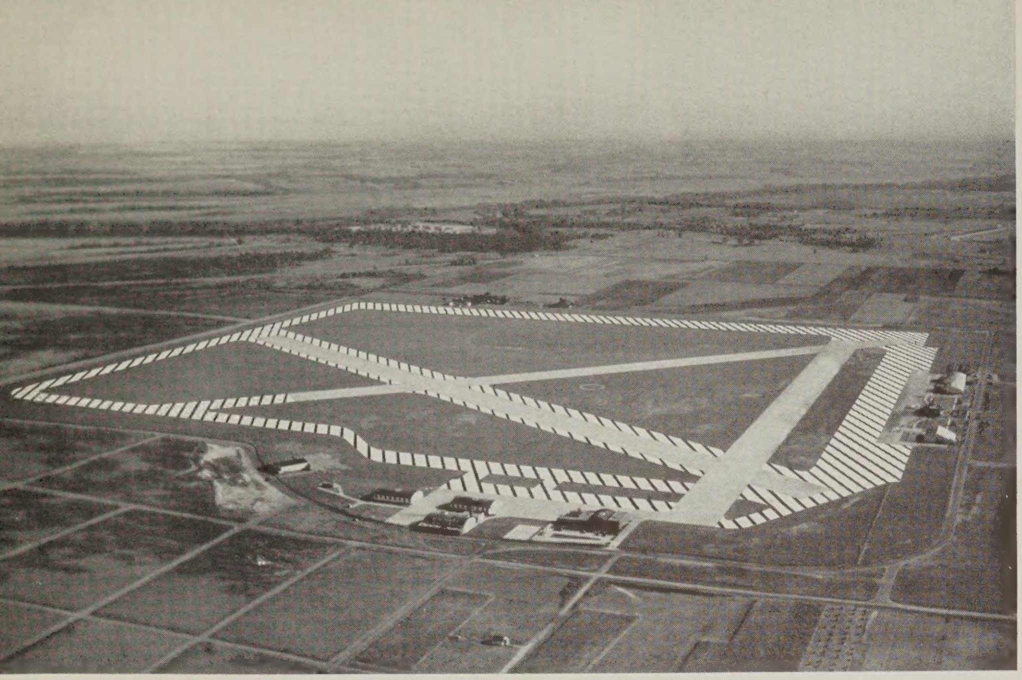
That is possible with concrete. Dr. H. M. Westergaard, dean of the Graduate School of Engineering of Harvard University, long recognized for his engineering research, has made a special study of concrete airport pavement stresses which furnishes engineers with a rational basis for design. Concrete pavement of ample strength may be assured without use of wasteful overdesign.

Under all but the most exceptional conditions the first cost of concrete pavement, properly designed, will be less than that of any other type of surface having equal carrying capacity. Cheaper surfaces, of less carrying capacity, may be constructed. But short life and heavy maintenance costs which result from their inadequacy will make them more expensive in the long run.

That concrete has the lowest *annual cost* has been demonstrated over and over.

Photo courtesy United Air Lines

Runways must be designed to carry anticipated loads as well as current plane weights running up to 140,000 lb. With concrete, engineers can design economical airport pavements for any load requirement.



Wold-Chamberlain Airport at Minneapolis is widening existing runways and building new ones to accommodate ever-increasing air traffic. Hatched portions show most recent additions to airport paving.

HAS LONG LIFE

Concrete airport runway pavements have already been in use long enough to prove that they have the strength and durability to give long years of useful service. Runways up to 12 years old give little evidence of the passage of the years. What their ultimate useful life will be can be determined from highway service records.

These records show that concrete pavement has a useful life expectancy of 25 to 30 years. With today's improvements in design and construction, an even longer useful life can reasonably be expected.

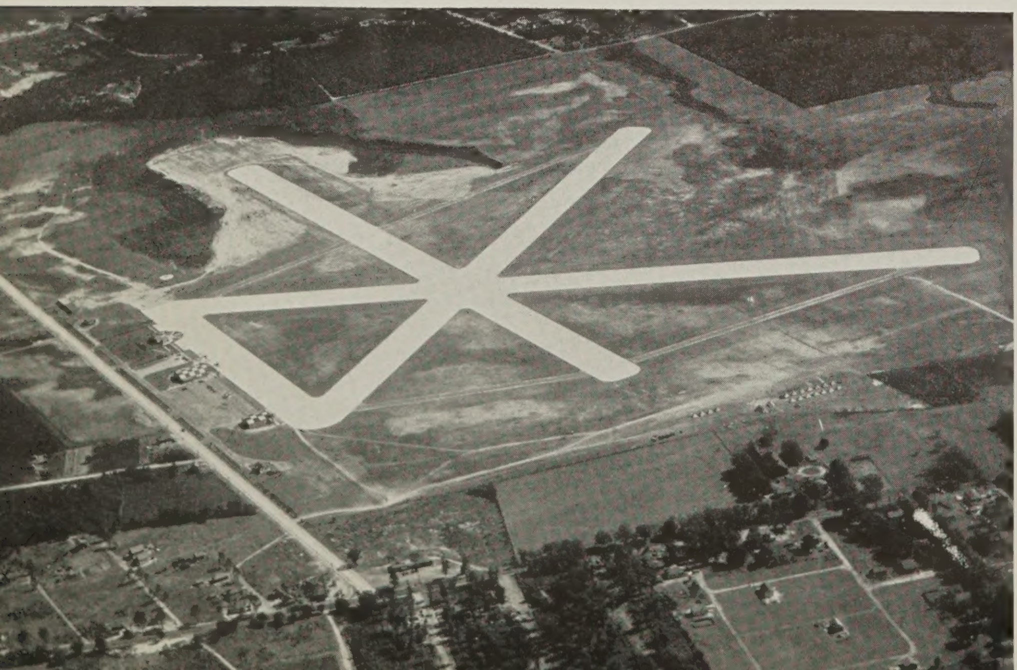
Long life is a principal reason for the growing acceptance of concrete runways. At many airports other type runways have proved inadequate to carry modern air traffic. After only a few years they have had to be rebuilt. Some of them have been rebuilt with concrete to avoid expensive reconstruction.

COSTS LESS TO MAINTAIN

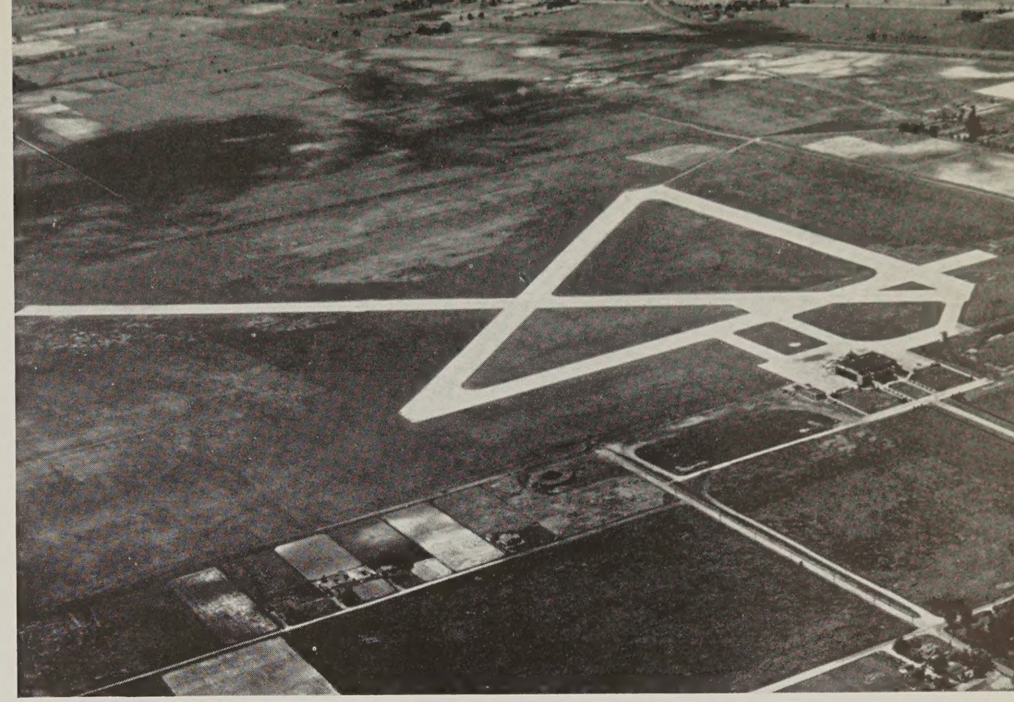
When properly designed and built, concrete airport pavement will carry current and anticipated traffic for many years with freedom from those structural failures which require costly repairs and reconstruction. Concrete does not need periodic retreatment or resurfacing. Upkeep will usually be limited to sealing joints.

Some airport managers report that practically no maintenance money has been required on their concrete runways in the past five to ten years—years which have seen an astonishing increase in plane weights and which have given the greatest impetus to air traffic.

Further conclusive evidence of the low maintenance cost of concrete pavement is found in the records of state highway departments. They show that other types of roadway take 72 per cent to over 500 per cent more money for surface maintenance than concrete does. Service records to date indicate



Concrete runways are easily sighted far from the airport. This is the Rhode Island Airport at Hillsgrove. Built in 1935, these runways have required practically no maintenance.



Concrete's low rolling friction permits planes to take off with maximum loads. The Municipal Airport of Indianapolis, Ind.

that savings in maintaining concrete *airport* pavement over other types will be even greater than on roadways.

IS EASY ON EQUIPMENT

Because of the evenness and high visibility of concrete runways, landings are smooth and easy. Landing gear, tires and wings are protected against excessive strains.

Of major importance is the saving in maintenance on propellers, engine cooling fins and control surfaces, due to concrete's freedom from loose stone chips and gravel. Airlines spend enormous sums removing dents and replacing equipment damaged by flying particles.

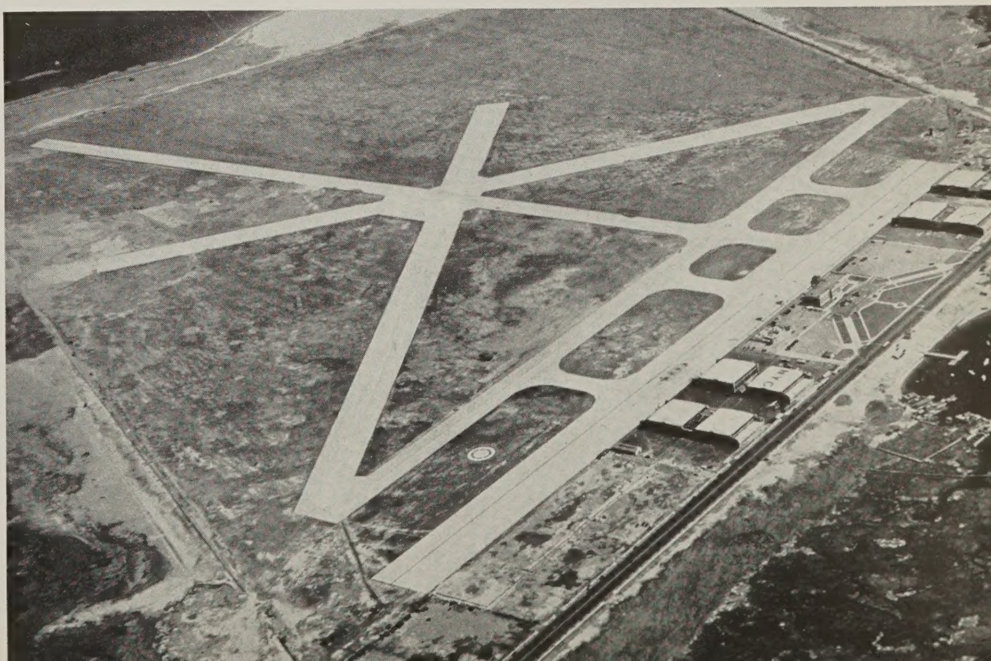
COSTS LESS TO LIGHT

Because concrete has a much higher light reflection factor than dark colored pavement surfaces, adequate illumination can be obtained with a much smaller lighting installation. There is a saving in initial cost of cables, transformers and lighting units. There is a continuing saving in current to operate the lights.

These facts are clearly shown by a published report of a lighting expert covering an incident at a large western airport. A satisfactory lighting installation became entirely inadequate when light colored runways were covered with dark oil. An increase of over 70 per cent in lighting only partially restored the efficacy of the lighting system.

PERMITS MAXIMUM PAY LOADS

The same low rolling friction of concrete which enables either commercial or military planes to get into the air quickly helps them to get off with full load of fuel and maximum cargo. There is less probability of having to leave part of the load behind or of having to put on an additional flight to handle it. Here, also, concrete runways mean increased economy.



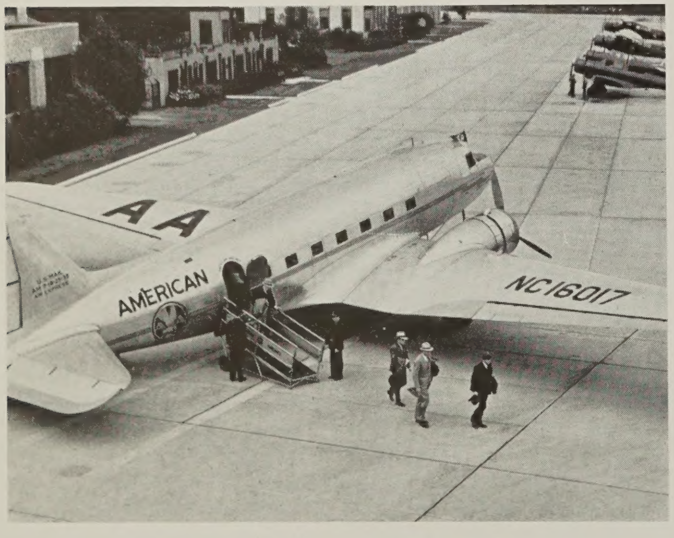
For 10 years after Floyd Bennett Field, New York City, was built, little or no money was spent on maintaining its concrete runways. It is one of the busiest fields in the country.

Photo courtesy United Air Lines

Passengers like CONCRETE

Passengers are assured that concrete makes their flight more pleasant; the take-off and the landing more safe, comfortable and shock-free.

Photo courtesy American Air Lines



THE airport is a city's front door to thousands of busy men who travel by air. They are favorably impressed by the obvious stability and permanence of concrete airport pavement.

They like the cleanliness of concrete.

They like its high visibility as they approach an airport. It gives them a feeling of security, of a safe harbor awaiting them.

Then there is the effortless, smooth landing. Bumps and bounces are at a minimum when the landing is on concrete. Almost before they realize it the plane has taxied swiftly up to the platform.

Pilots like CONCRETE

THE pilot who takes off or lands on concrete runways is free to devote his entire attention to the plane. He doesn't have to worry about skidding, about water pockets, loose stone chips, irregularities in the pavement surface. He knows that the pavement is completely adequate.

He appreciates its high visibility—a factor of first importance. Even the layout of joints helps him judge his altitude accurately, a difficult feat on surfaces uniform in color. The "ladder effect" of the transverse and longitudinal joints of concrete pavements gives just the needed perspective so that errors in judgment are avoided in landing.

Experienced pilots know that so-called "resilient" surfaces have no practical cushioning effect when landing—that the cushioning effect supplied by any pavement surface is negligible compared to that provided by the plane's tires and shock absorbers.

Pilots like concrete pavement because it helps them to operate their planes with safety, comfort and economy.

Management likes CONCRETE

AIRLINE operators and airport officials like concrete because it aids safety and they know that accidents cost money.

They like the light color of concrete with its ease of lighting and greater visibility.

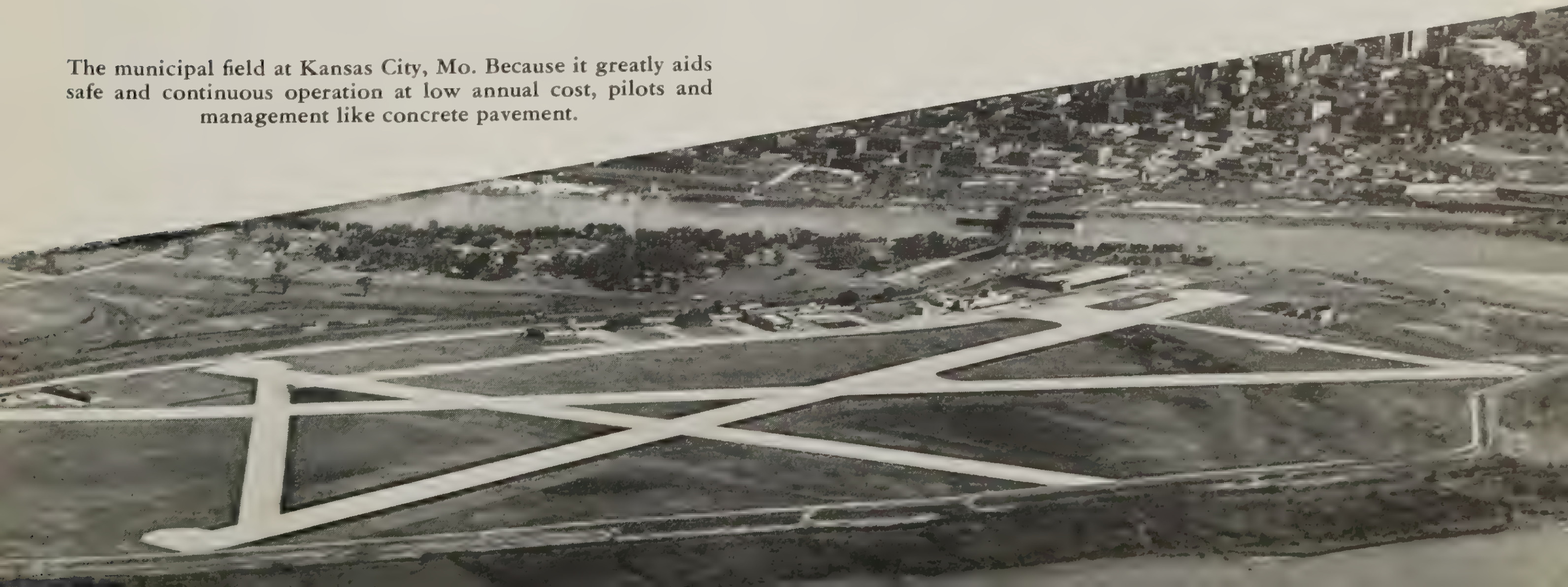
The airport official likes concrete because its maintenance cost is low. He knows that with concrete he will not have to rebuild or resurface every few years.

Management likes concrete airport pavement because of its cleanliness, durability, and dependability. With operators using the best flying equipment available, it is false economy to operate these planes on anything but the best airport pavement.

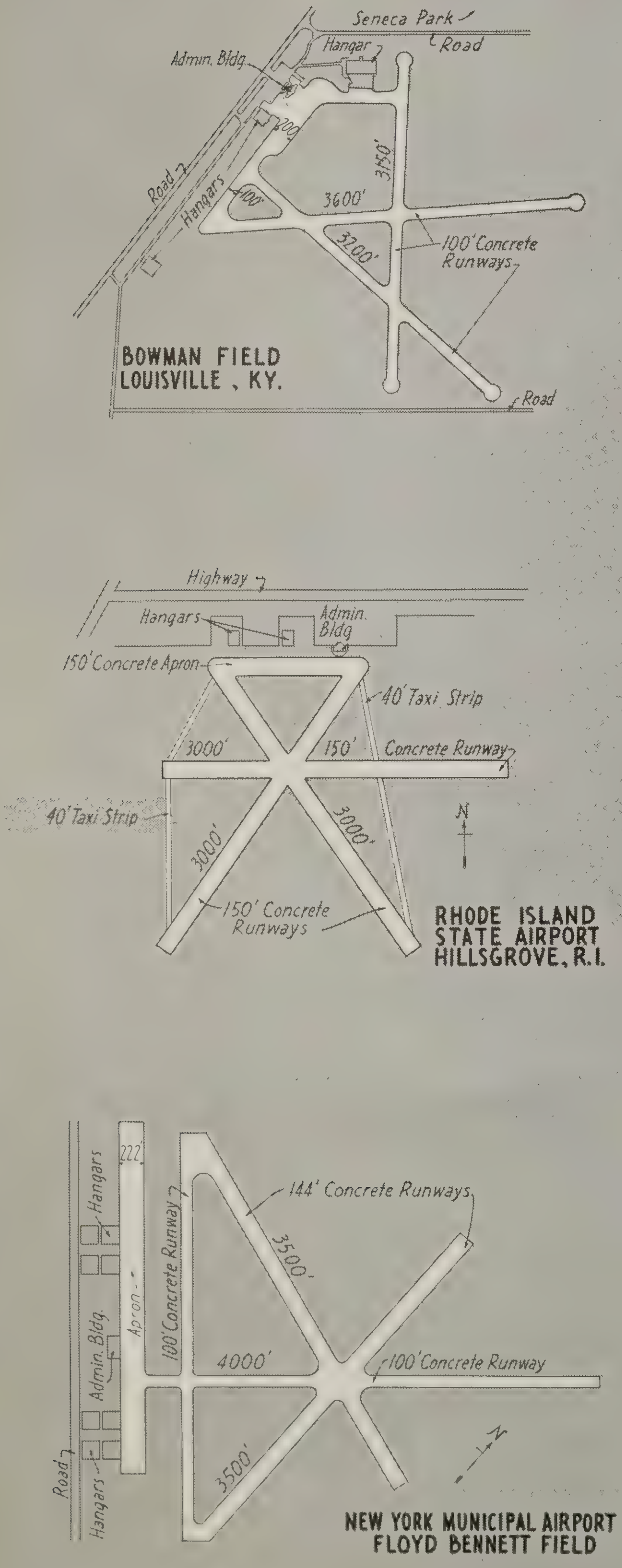
The entire layout of concrete pavement for runways, aprons, and taxiways at an airport of moderate size may actually cost less than *one* modern transport plane.

Management knows that in addition to being the best, concrete actually costs less per year.

The municipal field at Kansas City, Mo. Because it greatly aids safe and continuous operation at low annual cost, pilots and management like concrete pavement.



Three typical sketches showing how actual airports have been laid out to take advantage of prevailing winds, terrain and space available. *Top:* Bowman Field at Louisville, Ky. *Center:* Rhode Island State at Hillsgrove. *Bottom:* Floyd Bennett Field at New York City.



PLAN AND BUILD

DURING the next few years there will be large expansion of airport facilities. Construction of these facilities should be carried out as part of a sound engineering and economic plan providing for the ultimate complete development of the airport.

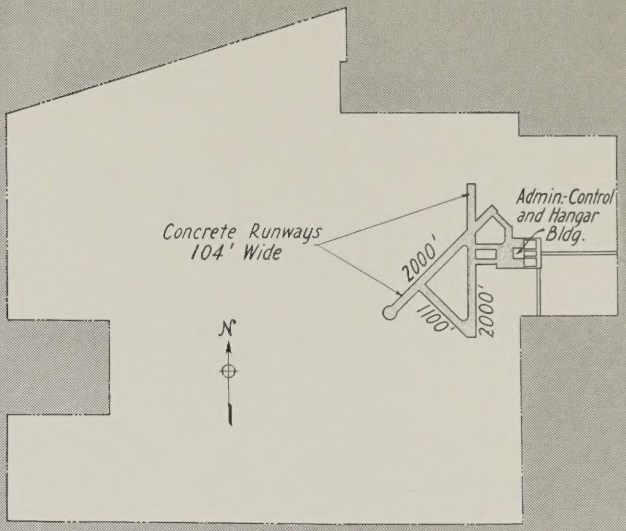
Use of inferior or inadequate materials does not fit into any such planned program. Runways, for example, which require excessive maintenance or which have to be rebuilt every few years are not economical. On the other hand concrete runways are. Savings in maintenance and reconstruction costs made possible by using concrete will help finance new construction.

If traffic does not justify doing the whole job at once, step-by-step construction—followed at many airports—is the logical financial and engineering procedure. The important thing is to build into airport pavement those advantages which concrete supplies so that each new

A rational program of airport construction provides for building of concrete the facilities that are needed most and extending them as traffic requires. These two concrete runways at Toledo, Ohio, built in 1940, are the first in a development program.

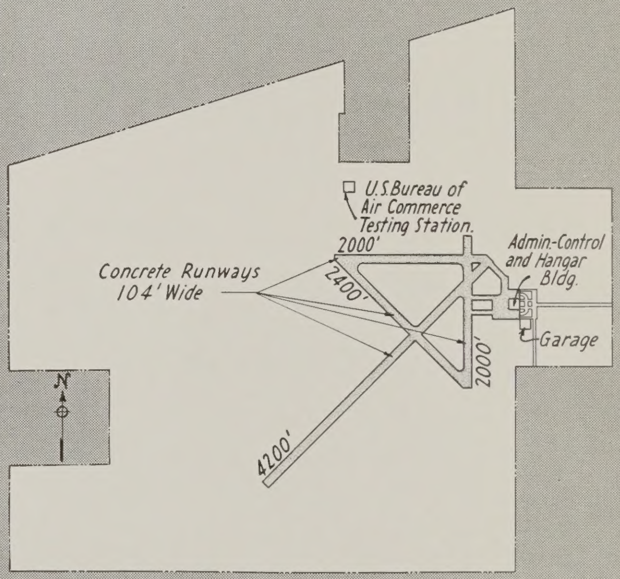
FOR THE FUTURE

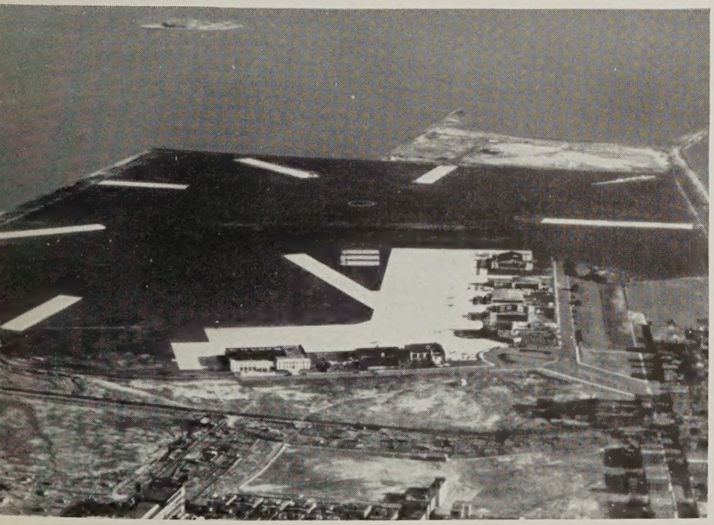
At the start, Indianapolis (see sketches at right) adopted a sound engineering plan for development of its airport. The plan embraced construction of runways, as needed, with low annual cost concrete. Thus, expensive reconstruction of temporary surfaces was avoided—maintenance cost was held to a minimum. Funds thus saved were available for new construction as needed to follow through on the original plan. Top: *The first concrete runways built under the plan.* Center: *Current status of the runways.* Bottom: *Indianapolis Airport when the plan is completed.*



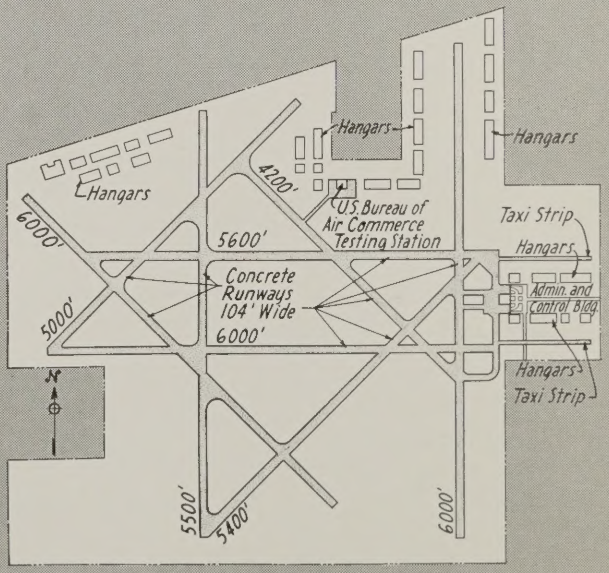
piece of construction fits into its place in the ultimate plan.

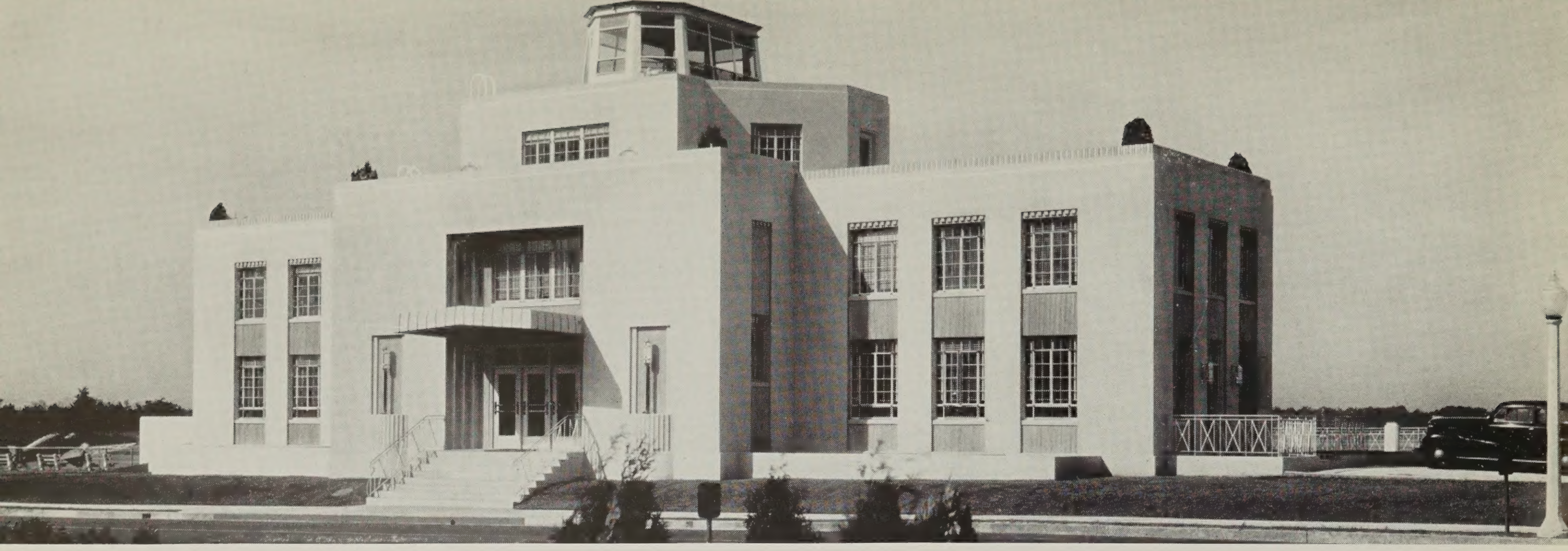
A forward-looking plan aimed to provide adequate facilities as they are needed at the lowest annual cost is essential to economical airport development.


U.S. Bureau of Air Commerce Testing Station.
2000'
Concrete Runways
104' Wide
2400'
Admin-Control and Hangar Bldg.
Garage
2000'
4200'
N



The important end sections of Boston's runways are of concrete, thus assuring easy landings, comfortable and safe starts at the take-off. This is a practical plan to get some of the advantage of concrete runways prior to their full development.





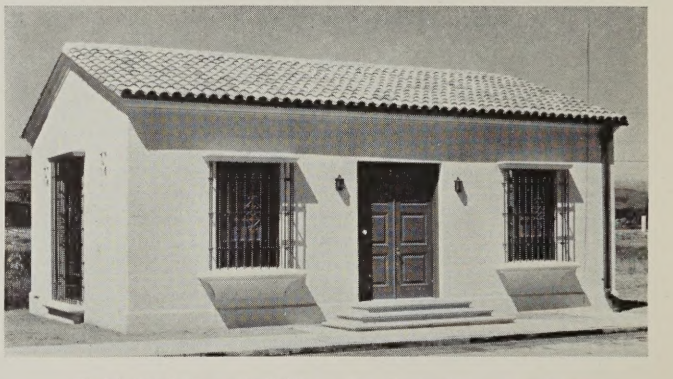
Administration Building at Memphis Airport.

ARCHITECTURAL CONCRETE

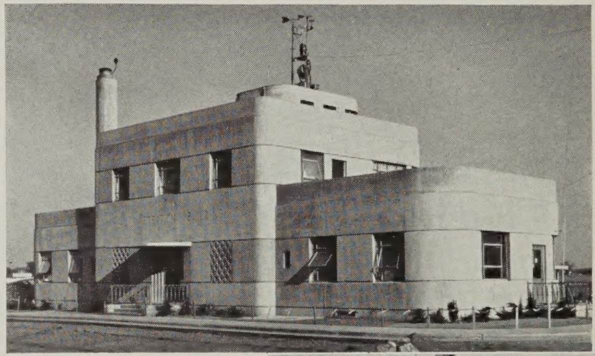
meets tempo of modern flying

MODERN airport buildings should be resistant to fire and storm, economical to construct and maintain, pleasing in appearance and long lived. Architectural concrete is the modern construction material for modern airport buildings, large and small.

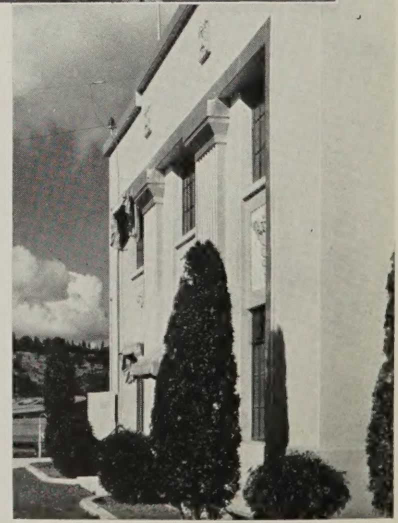
Sleek and trim as the great silver airliners which they serve, architectural concrete catches the fluidity and moving design suggested by speed and forms it into graceful lines and masses. Architectural concrete buildings leave pleasing impressions with air-minded men.



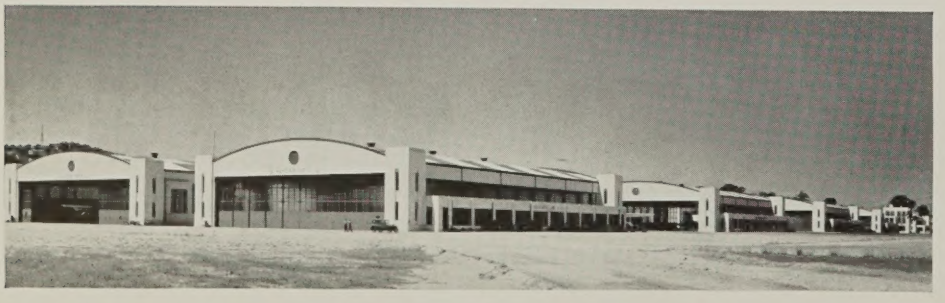
Field Lighting Building, San Francisco Airport.



Administration Building at Grand Rapids, Mich.



Administration Building at Felts Field, Spokane, Wash.



Hangars at Hamilton Field, near San Rafael, Calif.

AVERY CLASSICS

FOR NATIONAL DEFENSE

THE same properties which enable concrete airport pavement to satisfy the normal demands of peace-time flying fit it for the urgent needs of national defense.

Pavement must have inherent strength to carry the wheel loads of heavy military planes. Concrete can be designed to economically carry any number and weight of planes without interruption for costly, time-consuming repairs or reconstruction. Even the lighter cross sections of concrete will handle a surprisingly large number of heavy planes.

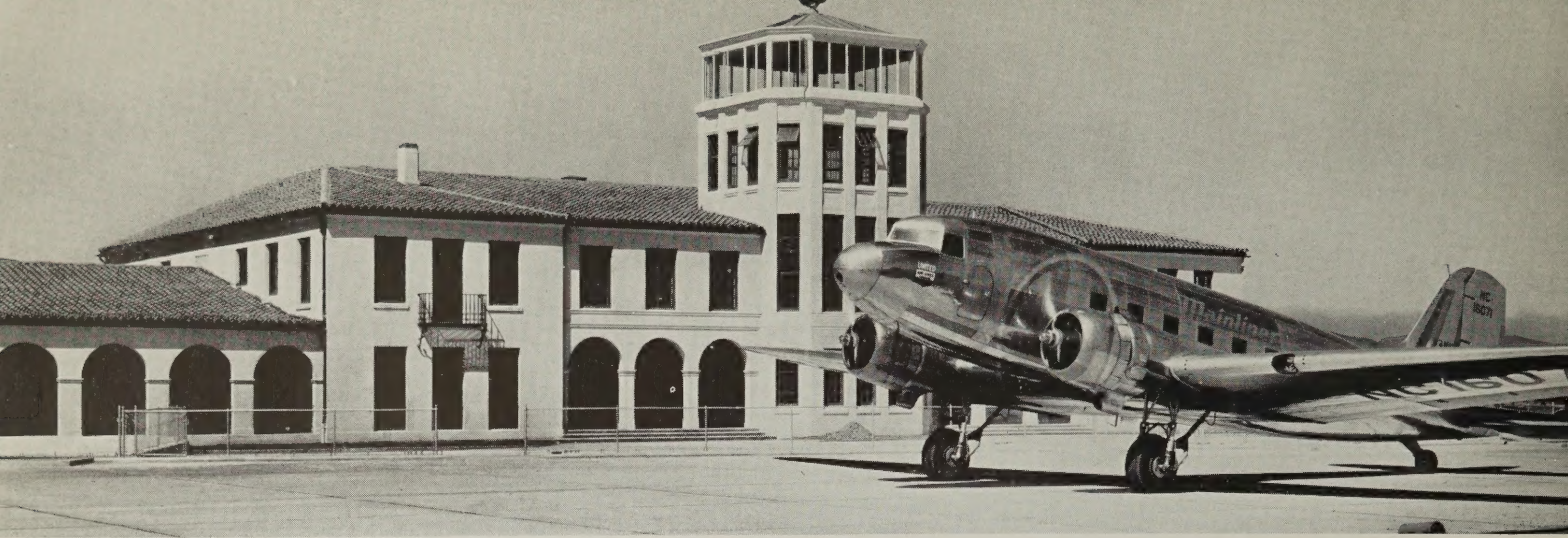
Concrete pavement increases the range of military planes and helps them get into the air with full loads. It insures maximum efficiency of operation.

The high visibility of concrete runways which contributes so much to peace-time safety can be temporarily, cheaply, and quickly camouflaged in an emergency.

Skilled concrete pavement contractors with modern power equipment and trained personnel are available to pave concrete runways, taxiways, and aprons with maximum speed. And when runways are paved with concrete they have the reserve strength to meet the demands of peace-time development or national emergency.

Randolph Field, Texas

Official photograph, U. S. Army Air Corps



San Francisco Airport.

Send now for these quick aids to better airport development

The Portland Cement Association through its district offices has available for immediate distribution up-to-the-minute information on how to get the best results from cement and concrete in airport construction. Booklets, manuals, information sheets and detail drawings relating to airport development are available without obligation to airport officials and engineers. Write today to our district office nearest you, stating your particular problem. Material is available on the following subjects:

AIRPORT PAVEMENT. Includes rational design of concrete pavements, control of concrete mixtures, proportioning of concrete materials, design of concrete runways, inspection during construction, low maintenance cost of concrete roadways.

ARCHITECTURAL CONCRETE. Includes valuable design, form and construction details and many suggestions on how to secure beauty, economy and firesafety in architectural concrete buildings.

STRUCTURAL CONCRETE. Design and construction data on how reinforced concrete is applied to frames, walls and floors of hangars, administration and other buildings large and small; covers rigid frame, tied-arch and Z-D systems.

CONCRETE MASONRY CONSTRUCTION. Covers economical design and construction of firesafe structures built with precast concrete units, and ways to obtain beautiful interior and exterior textures and finishes on walls.

CONCRETE FLOORS AND SIDEWALKS. Basic data on economical design and construction of concrete floors and sidewalks applicable to airport use.

CONCRETE PIPE. Practical facts explaining how strong, durable concrete pipe effectively drains subgrades—prerequisite to planned airport development.

SOIL-CEMENT. Details of testing and field uses of soil-cement.

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An organization to improve and extend the uses of concrete.

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